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Roasting biomass may be key process in bioenergy economy

IDAHO FALLS — Biorefineries may soon rely on a process akin to roasting coffee beans to get more energy-dense biomass.

A new collaborative study between Idaho National Laboratory and Pacific Northwest National Laboratory (PNNL) will investigate whether such roasting can create a more valuable product for the nascent biofuels industry. Initial studies show that driving moisture and volatile compounds from wood or straw could make the biomass more stable, compactable and energy dense.

"This could cut a lot of costs by providing a less expensive and higher-value product," said INL biofuels researcher Christopher Wright. "This technology has the ability to overcome biomass's moisture, mass and energy density problems, which make up a huge proportion of the cost barriers."

The technology he refers to is called "torrefaction" — heating biomass above 250 degrees Celsius in an oxygen-free environment. "It's not very different from roasting coffee beans," said Wright. But while coffee beans are roasted for flavor, biomass could be "torrefied" simply to improve its physical characteristics.

Two characteristics that heavily influence the logistics and economics of today's biomass industry are moisture and density. Most biomass is wet, which complicates long-term storage; and it's not very dense, which compromises the cost efficiency of mass transportation. Driving out moisture and volatile compounds through this process could address both issues.

Torrefied biomass has almost no water and actually becomes water resistant, which could improve storage in humid climates. The torrefied product also breaks down more easily so it's more uniform after grinding.

With research funding from the U.S. Department of Energy's Office of the Biomass Program, INL researchers are now torrefying biomass to further study physical characteristics of the dried product, its production cost and how much energy it could generate.

For example, they want to know whether the deeply dried biomass is easier to compact into pellets or briquettes. The energy used in the torrefaction process and the resulting energy content of the torrefied biomass needs to be measured to determine production costs. Collaborators at PNNL led by researcher Doug Elliott's team will study whether the torrefaction process improves the quality of the resulting biorefinery product.

"We want to understand if the properties of the torrefied biomass can improve the overall conversion of biomass into fuels," said Elliott.

INL recently shipped 30 kilograms of both raw and torrefied white oak to the PNNL team. Future shipments will include torrefied corn stover, wheat straw, switchgrass and two types of woody biomass.

Both research teams are eager to determine whether torrefaction can economically deliver a more stable, energy-dense feedstock that can be effectively converted into higher quality products at biorefineries. If so, the process could help cellulosic biomass compete as a nationally traded energy commodity.

"This may open access to more material," said Wright. "INL is looking at whether it's possible to create a homogeneous commodity product from biomass."

INL is one of DOE's 10 multiprogram national laboratories. The laboratory performs work in each of DOE's strategic goal areas: energy, national security, science and environment. INL is the nation's leading center for nuclear energy research and development. Day-to-day management and operation of the laboratory is the responsibility of Battelle Energy Alliance.

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